



Directorate of Laboratory Medicine

Paediatric Biochemistry User Guide

(May 2015)



Change Archive

Changes in May 2015 review:

- Harmonised paediatric creatinine reference intervals – page 15
- Cystatin C reference Intervals – page 15

Changes in April 2015 review:

- Addition of table highlighting effects of interference by Haemolysis, Icterus and Lipaemia - page 10
- New TPMT service – page 17
- Drugs reference ranges - page 20 and 21
- Carbamazepine Epoxide now available only as a send away test - page 20

Changes in April 2014 Reference Range review:

- Numerous minor changes

Changes in April 2014 review:

- Paediatric Duty Biochemist Extension number – page 5
- P1NP information added – page 21
- IGF-1 information added – page 20

Changes in October 2013 review:

- Samples for Retinol should be protected from light – page 13.
- Units for Retinol and Tocopherol, reference intervals and conversion factors updated – page 13
- Adult Zinc lower limit changed to 10 from 12 $\mu\text{mol/L}$ – page 14



- Alkaline phosphatase reference intervals updated: pathology harmony values for adults, new ranges from local data for babies 0 to 18 months – pages 9 and 10

Changes in September 2012 review:

- All Pages: Document Control header and footer updated.
- Location of laboratories updated – page 3
- New 'phone extension for paediatric duty biochemist 17594 – page 4
- Removed Vitamin D from 'Code Blue' table – page 5
- Stool for sugars chromatography: info from p21 now matches that in 'code blue' table – page 5
- Sample type for lipids is now Heparinised blood – page 12
- Digoxin can be either heparinised or clotted specimen – page 16
- Re Antibiotics TDM, lab no longer contacts pharmacist to alert to abnormal levels – page 18
- Insulin and C-Peptide Reference Intervals updated – P18
- Faecal Occult Blood test no longer available – page 21

Changes in May 2012 review:

- Page 10: Schwartz equation error - corrected.



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Location of Laboratories

The Main Laboratory is located on the Ground Floor of the Pathology Clinical Sciences Centre CSB3, MRI.

The Specialist Paediatric Laboratory is located on the first floor of the same building.

The Newborn Screening Laboratory (formerly the Hypothyroid Laboratory) is located within Genetic Medicine on Floor 6 of Tower 1 of the New St Mary's Development.

Telephone Numbers

Mrs. L.J. Tetlow, Consultant Clinical Scientist - Ext 11268 (office) or 15294(Lab)
Dr C Chaloner, Consultant Clinical Scientist - Ext 12752 (office) or 12250 (Lab)
Paediatric Duty Biochemist – Ext 12255
Paediatric Core Laboratory - Ext 12233
Newborn Screening Laboratory - Ext 12262

Laboratory Core Hours

Monday - Friday 0900 - 1724hrs (Core Biochemistry)
 0800 - 1724 hrs (Specialist Biochemistry)
Saturday 0800 - 1200hrs

On Saturday and Bank Holiday mornings (Core Biochemistry only) requests should reach the laboratory by 1030hrs and should be restricted to those investigations required for immediate patient management.

At other times, a shift-system providing a near complete service is provided. The person on-call may be contacted via the appropriate hospital Switchboard.

Time limits for add-on analyses

Sometimes, a crucial investigation is missed from the original request. We are happy to add analyses to a current request provided we have an appropriate specimen and we receive a new CWS request form for the add-on.

However, some tests are adversely affected by a delay to analysis, in particular potassium, magnesium, phosphate, bicarbonate. These tests must be added before the specimen is 2 hours old and can not safely be performed in older samples.

Most other analytes are more robust, but you should contact the laboratory on x12233 for specific advice.



Urgent Investigations

Telephone the laboratory first.

Urgent Requests during Normal Hours:

Some urgent tests can be sent in the Vacuum tube system. Some particularly precious and/or fragile samples require urgent Porter delivery. Sodexo help desk has the list of tests below for which a porter-response time of 5 minutes is targeted. These are termed 'Code Blue' tests. This form of words must be used when contacting the Sodexo helpdesk x4850.

Code Blue Samples = Specimens from New Royal Manchester Children's Hospital requiring rapid delivery and/or on ice:

Analyte	Maximum Acceptable Delay (minutes)
ACTH	15 on ice
Ammonia	15 on ice
AVP	5 on ice
Beta Hydroxybutyrate / FFA	20 on ice
Calcitonin	5 on ice
Chain-of-Custody medico-legal specimens	Discuss with lab on x12233
Gases, Capillary and Syringe	20 on ice
Gut Hormones	20 on ice
Insulin / C-Peptide	30 on ice
Jejunal Disaccharidases	Flash freeze in Liquid N2 at Theatres. Discuss
PTH	20
Renin / Aldosterone	30 NOT on ice
Stool for Sugars chromatography	20, or freeze immediately at source and transport to lab frozen

The requesting clinician **MUST** contact the laboratory before the specimen is sent. The request form must be marked 'URGENT' otherwise the sample may not be identified as one requiring immediate attention. Failure to contact the laboratory will result in the sample being treated as non-urgent. **Ensure that the report form includes the name and bleep number of the doctor who should be contacted when the results are available.**

Outside core working hours:

The person "on-call" should be contacted via the hospital Switchboard. A range of Biochemical Investigations may be available outside core hours, but only after prior discussion with the on-call Consultant Biochemist. All the investigations below are



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available without consultation with the Duty Consultant Biochemist. Please contact the laboratory before sending the specimen. Arrangements for Vacuum tube and 'Code Blue' are as for the Core Day.

Blood

Amikacin levels
Ammonia
Amylase
Bilirubin (total)
Bilirubin (conjugated)
Bone profile (including Calcium and phosphate)
Cholesterol
Creatinine
Creatine Kinase
CRP
Gases
Co-Oximetry
Gamma glutamyl transferase
Gentamicin
Glucose
Iron and TIBC
Lactate
Lactate Dehydrogenase
Liver Function Tests
Magnesium (plasma)
Orosomucoid
Paracetamol (minimum 4 hours post exposure)
Salicylate (often measured at same time as paracetamol. If positive repeat 6 hours later to ensure levels not rising)
Theophylline
Tobramycin
Triglycerides
Urea and Electrolytes
Uric acid
Valproate
Vancomycin

CSF

Glucose
Lactate
Protein



Urine

Urea, Electrolyte and Creatinine

These may be requested on spot or timed urines:

Timed urine U&E

- Transplant patients immediately post-op (usually 4 hourly collections).

Spot urine U&E

- First urine passed on patients with suspected renal failure

Spot urine sodium

- Patients with hyponatraemia/hypernatraemia
- New/relapsed nephrotics

ALL other requests for clinical biochemistry must be referred to the Duty Consultant Biochemist.

Key to specimen types and containers:

H : Lithium heparin, orange capped tube.

C : No anticoagulant, plain white-capped tube.

C/H : Either of above - heparinised sample will give better plasma volume yield on small samples.

F : Fluoride, yellow capped tube.

E : EDTA anticoagulant, pink-capped tube.

X : Special tube/container obtainable from laboratory by arrangement.

Where appropriate the MINIMUM volume of blood/sample is given in ml, therefore C 0.5 means clotted sample (no anticoagulant) and 0.5 ml blood required ASSUMING A NORMAL PACKED CELL VOLUME (PCV). Where groups of tests are requested the



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individual volumes can be reduced i.e. 1.0 ml of blood in a lithium heparin tube is sufficient for U/E, LFT, calcium and phosphate.

It is helpful to number the requested analytes in order of priority especially in the case of small samples.

All blood samples should be venous/arterial except for gases, neonatal bilirubins, glucose, antibiotics, HbA1C, which may be collected from a capillary if a good blood flow is obtained. Other analytes may be affected if collected from capillaries and should be discussed with laboratory before collection. Please contact routine biochemistry if you are experiencing problems with capillary collection of above samples. (See Appendix 1). Capillary Specimens **MUST** be clearly marked on request form as such.

Completing Request forms on Clinician Workstation (CWS)

It is recommended that you complete **all** fields in the CWS request window as completely as possible. The minimum data set for acceptance is forename, surname, date of birth and hospital number. However, we ask you to pay particular attention to the fields for bleep number (this is not necessarily YOUR bleep number, as it may be more appropriate to give a colleague's if you are going off duty, or are otherwise likely to be uncontactable) and also to ensure that you raise the request against the correct patient episode, particularly as some patients are seen at other locations (eg SMH).



Interferences from haemolysis, icterus and lipaemia

Analytical interference caused by pre-analytical factors is a significant source of error in clinical laboratory measurements. Analytical interference by haemolysis, bilirubin and lipids with laboratory assays is the most common concern in laboratory medicine. These altered results may lead to repeat tests, incorrect interpretation, wrong diagnosis, and potentially inappropriate intervention and unfavourable outcome for patients.

The table below details the impacts of haemolysis, icterus and lipaemia on laboratory tests:

Analyte	Effect of haemolysis	Effect of icterus		Effect of lipaemia
		Conjugated	Unconjugated	
Orosomucoid	-	-	-	↑
α1-antitrypsin	-	-	-	↑
Acetaminophen (Paracetamol)	Dependent on level of paracetamol (contact laboratory for information)			
Albumin				
Alkaline Phosphatase	↓	↓	-	-
ALT	↓↑	↓	↓	↓
Amikacin	↑	-	-	-
Ammonia	↓↑	↑	↓	↓
Amylase	↓	-	-	↓
AST	↑	-	-	↓
Bicarbonate	-	-	-	-
Bilirubin (Total)	-	N/A	N/A	-
Calcium	-	-	-	-
Caeruloplasmin	-	-	-	↑
Chloride	-	-	-	-
Cholesterol	↑	↓	↓	-
Creatine Kinase	↑	-	-	-
Creatinine	↓	↓	↓	↓
CRP	-	-	-	-
Gentamicin	-	-	-	↓
GGT	↓	-	↓	-
Glucose	-	-	-	↑
HDL	-	↓	-	-
Iron	↑	-	-	↓
Lactate	-	↓	-	-
LDH	↑	-	-	-
Direct LDL	-	-	-	↓
Magnesium	↑	-	-	-



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Phenobarbital	-	-	-	-
Phenytoin	-	-	-	↓
Phosphate	↑	↑	-	↑
Potassium	↑	-	-	-
Salicylate	-	-	-	↓
Sodium	-	-	-	-
Theophylline	-	-	-	↓
Tobramycin	-	-	-	-
Total Protein	-	↓	↓	-
Triglycerides	↑	↓	↑	N/A
UIBC	↑	↓	-	↓
Urea	-	-	-	↓
Uric Acid	-	↓	↓	-
Valproate	-	-	-	↓
Vancomycin	-	-	-	↓

Data taken from the Roche global package inserts and application report, July 2013. Table shows the impacts of haemolysis, icterus and lipaemia on laboratory tests on the Roche c501, c311 and c502 analysers. (Serum/plasma samples only). ↓ under-recovery, ↑ over-recovery, ↓↑ variable recovery, - no significant impact.



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Requirements and Reference Ranges

DISCLAIMER

Adult reference ranges quoted within this Paediatric Biochemistry User Guide reflect historical practice and methodological principles. They are under ACTIVE REVIEW and are in some instances different from those given in the Adult Biochemistry User Guide. Please speak to a member of the Paediatric Biochemistry team if you have any queries.

Analyte	Specimen Type / volume	Patient Age	Reference Range
Acid Base (blood gases)	pre-heparinised syringe, 0.5ml minimum or full heparinised capillary tube. Mix well immediately after collection to prevent clotting. Reference ranges below apply to arterial specimens only.	Please state if patient is on O ₂	
pH		2-4 weeks	7.38-7.47
		> 1 month	7.35-7.44
pCO ₂		2-4 weeks	2.5 - 6.0 kPa
		1-3 years	3.7 - 5.3 kPa
		3-7 years	4.1 - 5.3 kPa
		7-12 yrs	4.3 - 5.5 kPa
		12-18 yrs	4.5 - 5.7 kPa
pO ₂ (in room air)			10.7 - 13.3 kPa
Actual bicarbonate			19 to 28 mmol/l



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Base excess	Newborn	-10 to -2 mmol/l
	Infant	-7 to -1 mmol/l
	Child	-4 to +2 mmol/l
	Adult	-3 to +3 mmol/l

*Send labelled sample **on ice** to the laboratory immediately after collection. **Inform the laboratory before you send a gas.** Capillary samples require proper collection technique to ensure reliable results and are not recommended for the estimation of pO₂.*

Alanine

Aminotransferase (ALT)	H 1.0	up to 1 month	90IU/l
		Others	5 to 40 IU/l

Albumin	H 1.0	up to 1 mth	25 - 35 g/l
		2 - 6 mths	28 - 40 g/l
		7 mths - 17yrs	30 - 45 g/l

Alkaline phosphatase (ALP)	H 1.0		Female	Male
		0 – 7 days	75 - 300	75 - 300
		8 - 28 days	90 - 477	90 - 477
		29 – 90 days	90 - 540	90 - 540
		91 – 180 days	77 - 540	77 - 540
		181 – 360 days	87 - 382	87 - 382
		361 – 540 days	69 - 434	69 - 434
		> 540 days – 2 years	60 to 370	60 - 370
		2 – 8 years	60 – 320	
		2 – 10 years		60 - 300
		Pubertal	60 - 400	60 - 400
		Adult	30 - 130	30 - 130

Ammonia	X 1.3	Up to 14d	10 to 100 µmol/L
		Others	5 to 50 µmol/L

NOTE: PLASTIC EDTA TUBE

Note: May be higher in prematurity. Please arrange with laboratory before taking the sample which should be sent to the laboratory immediately in ice/water.

Amylase	H 1.0	child	less than 100IU/L
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Note: The normal distribution in adults is skewed with normal individuals occasionally

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producing levels up to 200 IU/l. A similar study has not yet been undertaken in children.

Aspartate

Aminotransferase (AST) H 1.0 up to 14 days 20 to 98 IU/l

15 days to 3 years 16 to 69
≥4 years 5 to 45

Bicarbonate H 1.0 20 - 26 mmol/l

Bilirubin, total H 1.0 full term infant 0 to 22 µmol/L
levels will rise from birth to approximately 150 µmol/l at 5 - 6 days and then fall to normal childhood levels by day ten.

Bilirubin, conjugated neonate up to 30 µmol/l

*Caeruloplasmin (only in conjunction with copper) X 4.0 (Cu/Caer) neonate 50 - 200 mg/l
6 months plus 200 - 450 mg/l

Note: Copper and zinc can be assayed on the same sample.

Calcium, whole blood, ionized H 1.0 Syringe, balanced heparin Independent of age 1.00 - 1.30 mmol/L

Calcium, plasma, total H 1.0 premature 1.50 - 2.5 mmol/L
Up to 2 weeks 1.90 - 2.8 mmol/L
child 2.2 - 2.7 mmol/L
Avoid venous stasis

Chloride H 1.0 98 - 110 mmol/l

Cholesterol, total H 1.0 up to 1 month 1.1 - 2.6 mmol/l
1m - 2yrs 1.2 - 4.7 mmol/l

Copper See above (Caeruloplasmin) up to 1 month 2 - 8 µmol/l
> 6 months 13 - 26 µmol/l

Note: Zinc may be estimated on same sample.

Creatine Kinase (CK) H 1.0 up to 2 wks 10 - 600 IU/l
up to 1 mth < 400 IU/l
up to 1 year < 300 IU/l
adult levels are reached at about 2 years of adult male < 190 IU/l

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age

		adult female	< 165 IU/l
Creatinine	H 1.0	0 - <14days	M 27 – 81; f 27 - 81
		14d - <1yr	M 14 – 34; f 14 - 34
		1 - <3yr	M 15 – 31; f 15 - 31
		3 - <5yr	M 23 – 37; f 23 - 37
		5 - <7yr	M 25 – 42; f 25 - 42
		7 - <9yr	M 30 – 48; f 30 - 48
		9 - <11yr	M 28 – 57; f 28 - 57
		11yr	M 36 – 64; f 36 - 64
		12yr	M 36 – 67; f 36 - 67
		13yr	M 38 – 76; f 38 - 74
		14yr	M 40 – 83; f 43 - 75
		15yr	M 47 – 98; f 44 - 79
		16yr	M 54 – 99; f 48 - 81
		>16 years to adult	55 – 104 (males) 45 – 84 (females)

eGfR (Estimated GfR)

This test is for use with Gentamicin levels only. 51Cr-EDTA test or Creatinine Clearance should be used for dosing with other potentially nephrotoxic drugs.	Calculated as part of a U&E	> 90 ml/min/1.73m ²
	[eGfR = 40 x height in cm /plasma creatinine]	Seek renal opinion for values below 90ml/min/1.73m ²

C-Reactive Protein (CRP)	H 1.0	0.3 to 5 mg/L
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Cystatin C	H 1.0	0 – 28d	0.80 - 2.30 mg/L
		29d – 12mo	0.70 - 1.50
		13mo – 17y	0.56 – 1.30
		18 – 50y	0.56 – 0.98
		>51y	0.61 – 1.40



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Fat absorption	H 1.0	Fasting rise in triglycerides and 2 > 0.45 mmol/l hours post dose	
Gamma Glutamyl Transferase (GGT)	H 1.0	0-4wks	10 – 270 IU/L
		1 - 2 mths	10 - 155 IU/L
		3 – 4 mths	10 - 93 IU/L
		5 mths - 150 yrs Male	10 - 71 IU/L
		5 mths - 150 yrs Female	6 - 42 IU/L
Glucose	F 0.5	up to 1 mth child	2.5 - 5.5 mmol/l} * 3.0 - 6.0 mmol/l} * * Fasting
		child	3.0 - 6.0 mmol/l} * * Fasting
Iron	H 1.0	1 month	10 - 30 µmol/l
		1 year	5 - 25 µmol/l
		child	10 - 25 µmol/l
		adult	7 – 29 µmol/l
<i>Note: Diurnal variation in iron levels so sample at 9am.</i>			
Iron Binding Capacity (IBC)	as above	1 month	20 - 60 µmol/l
		1 year	35 - 65 µmol/l
		child	40 - 70 µmol/l
		adult	45 - 75 µmol/l
Lactate	F 0.5 Sample must be < 2hrs old	fasting	0.6 - 2.5 mmol/l
Lactate Dehydrogenase	H/ C 1.0	< 4 week	130 to 750 IU/L
		5 weeks to 1 year	180 to 435 IU/L
		2 year to 3 years	160 to 365 IU/L
		4 years to 6 years	145 to 345 IU/L
		7 years to 9 years	140 to 290 IU/L
		10 years to 12 years male and female	M=120 to 325 IU/L F=120 – 260 IU/L
		13 years to 15	120 to 280 IU/L



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		years	
		16 years to 18	105 to 230 IU/L
		years	
		18 years and	20 to 220 IU/L
		above	
Lipid Profile incl LDL, HDL	H 1.0 FASTING	*	referral lab provides interpretation
Magnesium	H 1.0		0.70 - 1.0 mmol/l
Orosomucoid	H 1.0		300 - 1200 mg/l
Osmolality	H 1.0 Not done routinely. Can be calculated from plasma electrolytes		275 - 295 mOsmol/kg
Phosphate	H 1.0	1 month	1.4 - 2.8 mmol/l
		2 mo - 1 year	1.2 - 2.2 mmol/l
		2 - 3 years	1.1 - 2.0 mmol/l
		4 - 12 years	1.0 - 1.8 mmol/l
		13 - 15 years	0.95 - 1.5 mmol/l
		16 years to adult	0.8 - 1.40 mmol/l
Potassium (serum)	C 1.0	All ages	3.5 - 5.5 mmol/l
Potassium (plasma)	H 1.0	Up to 1 month	3.5 - 6.0 mmol/l
		2 months - 17 years	3.5 - 5.0 mmol/l
Protein, total	H 1.0	Up to 1 month	45 - 70 g/l
		2 mo - 1 year	55 - 72 g/l
		2 years to adult	60 - 80 g/l
Retinol (Vitamin A)	C 1.0		0.7 - 2.8 µmol/l
To convert µmol/L to mg/L x 0.286			
			Protect from light
Sodium	H 1.0	Up to 1 month	130 - 145 mmol/l
		1 month to adult	133 - 146 mmol/l



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Thiopurine Methyl Transferase	E 1.0	Deficient activity	less than 10 mU/L
		Low activity	20 - 74 mU/L
		Normal activity	75 - 165 mU/L
		Additional information:	Recent blood transfusion may mask a deficient result

Tocopherol (Vitamin E) To convert $\mu\text{mol/L}$ to $\text{mg/L} \times 0.431$	C 1.0		12 - 35 $\mu\text{mol/l}$ <i>lower in neonates</i>
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Triglycerides, fasting	C 1.0	Up to 1 month	0.1 - 0.9 mmol/l
		2 months - 1 year	0.4 - 1.4 mmol/l
		2 years to adult	0 - 1.7 mmol/l

Urate	H 1.0	Up to 1 month	0.08 – 0.50 mmol/l
		2 mo – 12 years	0.12 - 0.32 mmol/l
		13 years to adult male	0.18 - 0.48 mmol/l
		13 years to adult female	0.12 - 0.42 mmol/l

Urea	H 1.0	Up to 1 month	2.0 - 5.0 mmol/l
		2mo - 1 year	2.5 - 6.0 mmol/l
		2 – 12 years	2.5 - 6.5 mmol/l
		13 - 17 years	3.0 - 7.5 mmol/l

Vitamin A (see Retinol)

Vitamin E (see Tocopherol)

Zinc
serum levels decrease shortly after birth and regain childhood levels at a few months. Copper can be assayed on same sample.

CSF

Glucose	F 0.3	40% - 80% plasma level	also required.
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Lactate F 0.3 0.6 - 2.7 mmol/l plasma level also required

Protein Up to 7 days 0.4 to 1.1 g/L
1 to 4 weeks 0.4 - 0.8 g/L
1 - 3 months 0.2 - 1.7 g/L
3 months - adult 0.05 - 0.45 g/L

*2 ml plain ('clotted')
container

* 0.3

Biopsies

Disaccharidases Jejunal mucosa
(min wt. 2mg.) wrap
biopsy in silver foil,
place in 2ml screwcap
tube, place on ice
immediately

Maltase 12 - 45 IU/g wet wt
Sucrase 4 - 15 IU/g wet wt
Lactase 2 - 12 IU/g wet wt

Drug Overdose

Analyte	Specimen Type / Volume	Time post ingestion	Toxic Level
Paracetamol	H 1.0	4 hours	200 mg/l
		8 hours	100 mg/l
		12 hours	50 mg/l

NB These levels are for guidance only. Lower levels are toxic in patients at "high risk". For further information consult the nomogram in the A&E Department.

Salicylate H 1.0 6 hours* 300 mg/l

* Due to variable absorption salicylate should be measured on admission, or with paracetamol, and repeated at 6 hours if detected in the first sample.

Other Toxicology

Admission of Drowsy, Semi-comatose and Comatose Patients

When a patient is admitted it is not unusual for the clinician subsequently to query drug toxicity. The request may be indicated after it is too late to obtain the necessary specimens from the patient as the drug may have been metabolised and/or excreted.

On admission it is essential routinely to collect:

1. At least 20 ml of urine in a plastic container with no preservative (many drugs can only

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be detected in urine with current methodologies)

2. At least 2mls of clotted blood.

These specimens can be kept overnight refrigerated at 4 oC on the ward and sent to the laboratory the following day with a request form containing all relevant clinical information.

Where the result of laboratory investigations may be used as evidence in cases of non-accidental injury, the Chain-of-Custody procedure described below must be followed.

CONTACT THE LABORATORY FOR COPIES OF THE APPROPRIATE DOCUMENTATION

Procedure for requesting laboratory investigations in cases of suspected non-accidental injury

- A completed Chain-of-Custody form must accompany the request. These forms are available **ONLY** from the Biochemistry Department. These forms have an allocated "chain of custody" number. **On no account may they be photocopied.** All hospital staff taking or handling these samples must sign the Chain-of-Custody form.
- Take samples as soon as possible after admission, preferably with witnesses and handled by as few staff as possible.
- Care should be taken to ensure that specimen containers are correctly labelled and that the accompanying "normal" laboratory request forms are completed in full. The form must detail suspected drugs/time of ingestion also therapeutic drugs administered and clinical details.
- All containers must have the tops sealed on the ward with sellotape and then be carefully sealed in the bag of a routine Biochemistry request form. The person who collected the specimen must sign the sellotape seal.
- The samples must be taken directly to the Biochemistry Department, ideally by the person who has collected the specimens or alternatively by a member of the ward staff. Do not use the air tube or any other means of delivering specimens.
- Specimens must be delivered to a member of the laboratory technical, scientific or medical staff.

For further information regarding availability or interpretation of TDM or toxicology requests, contact either;

Mrs. L.J. Tetlow, Consultant Clinical Scientist ext. 11268 (Office) ext. 15294 (Lab)
or bleep via switchboard

Dr C Chaloner, Consultant Clinical Scientist ext 12752 (Office), 12250 (Lab) or via Switch

Serum / Plasma Therapeutic Drug Monitoring

Laboratory Medicine - Paediatric Biochemistry
Author: Paediatric Biochemistry Management Team



Paediatric Biochemistry

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Analyte	Specimen Type / volume	Optimal Range
Carbamazepine	H/C 1.0	4 - 12 mg/l trough level
~~Carbamazepine 10,11-epoxide~~		~~1 - 4 mg/l~~
Cyclosporin A (CyA)	E 1.0	12 hours post dose - state dose and timings. 1.0 - 2.0 µg/l
Digoxin	H/C 1.0	NB Sample must be taken at least 6 hours post dose.
Lamotrigine	H/C 1.0	3 - 15 mg/l
Phenobarbitone	H/C 1.0	trough 10 -40 mg/l
Phenytoin	H/C 1.0	trough 5 - 20 mg/l
Tacrolimus	E 1.0	12 hours post dose - state dose and timings. Trough 5 - 20 µg/l
Theophylline	H/C 1.0	asthma 10 - 20 mg/l apnoea 7 - 12 mg/l
Valproate	H/C 1.0	sample peak level 2 - 4 hrs post dose. trough 60 - 100 mg/l

Note : Contact the laboratory on 12243 for further information on sample requirements

Serum / Plasma Antibiotic Levels

Please refer to the Trust Antibiotic and Pharmacy guidelines.

Venous samples are preferred, though a finger prick (capillary sample) may be performed. Minimum volumes of 0.5 ml per specimen **must** be provided.

Target Concentrations For extended interval (single daily) dosing Gentamicin regimen, a single specimen between 12 and 24 hrs post dose must be provided. The timing of the specimen in relation to dose **MUST** be recorded and this information provided to the laboratory. For interpretation, refer to the nomogram in the document link below.

[Extended interval gentamicin in paediatrics: dosing policy](#)



For multiple daily dosing regimens, pre-dose concentrations are an indicator of accumulation and relate to toxicity. Post-dose levels are an indicator of distribution in the body and relate to efficacy. The target concentrations will vary according to the clinical condition of the patient for example cystic fibrosis and bronchiectasis patients require higher concentrations as their bodies remove the drugs faster. In most clinical situations, eg, post-operative, febrile neutropaenia, the standard concentration ranges given below are usually sufficient.

Standard Treatment:

	Specimen Type/Volume	Pre-dose conc (mg/l)	Post-dose conc (mg/l) EXACTLY ONE HOUR POST-DOSE
Amikacin	H 1.0	2-5	15-30
Gentamicin Multiple Daily Dosing	H 1.0	Less than 2 (ideally less than 1)	5-10
Tobramycin	H 1.0	Less than 2 (ideally less than 1)	5-10

Cystic Fibrosis and Bronchiectasis:

	Specimen Type/Volume	Pre-dose conc (mg/l)	Post-dose conc (mg/l)
Amikacin	H 1.0	Less than 10 (ideally 2-5)	25-30
Gentamicin Multiple Daily Dosing	H 1.0	Less than 2 (ideally less than 1)	8-10
Tobramycin	H 1.0	Less than 2 (ideally less than 1)	8-10
Vancomycin	H 1.0	5 -15	Post dose monitoring is no longer recommended

IMPORTANT

If concentrations are outside of these ranges, please ensure that you have sought pharmacist advice.



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Pharmacist Advice

Detailed guidelines have been drawn up to ensure continuity of advice given by the pharmacists and in many cases a pharmacist will request further information when contacting wards.

When a dose adjustment is necessary, the responsible pharmacist will contact a doctor responsible for the care of the patient to ensure agreement with respect of the advice given. Messages will not be left with nursing staff unless there are exceptional circumstances.

Endocrine Tests

Analyte	Specimen Type / volume	Reference Range
Cortisol	H 1.0	9am 200-700 nmol/l Late pm up to 100 nmol/l
<i>Diurnal variation established at about 3 months of age; Normal response post-Synacthen 30 minutes > 550 nmol / litre</i>		

Gonadotrophins (LH/ FSH) H/C 1.0

Follicle stimulating Hormone (FSH)	H/C 1.0	Up to 10 yrs < 3 U/l adult male 1-10 U/l adult female 1-9 U/l ovulatory peak 4-13 U/l postmenopausal 30-120 U/l
Luteinising hormone (LH)	H/C 1.0	0-2 years <3.5 U/l 2-10 years <0.3 U/l adult male 1-8 U/l adult female 0.5-13 U/l ovulatory peak 14-72 U/l postmenopausal 15-64 U/l
Insulin & C-Peptide	H 1.0	Fasting samples with normal glucose Insulin 2.0-25 mU/l C-Peptide 350-1800 pmol/l

Note : A fluoride sample for glucose taken at the same time is required. IF INVESTIGATING HYPOGLYCAEMIA, SAMPLES MUST BE OBTAINED AT THE TIME OF THE HYPOGLYCAEMIC EPISODE. The samples must be placed in a mixture of ice and water and sent to the Biochemistry laboratory immediately. Out of hours, the person on-call must be contacted prior to collecting the sample.



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Insulin-like Growth Factor
(IGF-1)

C 1.0

Age and gender specific
reference ranges. Please see
report

Growth Hormone

C 1.0

Level >5.8 microgrammes/L in
at least one sample on
stimulation

17 alpha
hydroxyprogesterone

H 0.5

Neonatal samples should not
be
taken in first 48 hours
Full term infant 0 - 25 nmol/l
Premature infant 0 - 40 nmol/l
Children & Adults 0 - 6 nmol/l

Independent of age

Parathyroid Hormone (PTH) E 1.0

Normocalcaemic patients 10-60
pg/ml

Note : Change of sample type and reference interval from 14th June 2010. Samples must
be sent immediately to the laboratory. Bleep BMS out of hours

Procollagen Type 1 Amino
Terminal Peptide (P1NP)

H 1.0

27-128 µg/L

Renin

E 1.0

Supine 0.1-2.0 ng/ml/h
Upright 1.5-5.7 ng/ml/h
Upright 1.5-5.7 ng/ml/h

Note : Levels higher in infants and early childhood. Special tube obtained from
Biochemistry or Newborn Screening Lab. Sample must be sent to laboratory
immediately.

Thyroid Function Tests H 1.0
Thyroid Stimulating Hormone (TSH)

<1 month up to 10 mu/l
Child & adult 0.2 - 5.0 mu/l

Free Thyroxine (FT4)

<1 month 15-34 pmol/l
Child & adult 9 - 24 pmol/l

Urine Catecholamines

Laboratory Medicine - Paediatric Biochemistry
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Analyte	Sample
Dopamine	
HMMA (VMA)	A 24 hour urine collected into acid, container supplied by laboratory is the preferred specimen, for which reference ranges have been established. In infants in whom it is difficult to obtain 24 hour specimens, shorter collections or random urine may be used. Send sample to laboratory immediately if not collected into acid
HVA	
Noradrenaline	

See individual report for reference ranges.

Urine - other

Analyte	Specimen Type / volume	Reference Range
Albumin/Creatinine Ratio	1st urine of the day	< 2.1mg/mmol creatinine
Albumin Excretion Rate	Timed collection, usually overnight	< 10µg/min
Calcium	24 hour	child < 0.1 mmol/kg/24hrs adult 2.5 - 7.5 mmol/24hrs

Note : Special container from laboratory

Calcium/Creatinine Ratio	10 ml of the 2nd urine of the morning. Alternatively post prandial. FRESH URINE SPECIMEN MUST BE SENT TO THE LABORATORY IMMEDIATELY	up to 0.56 mol/mol creatinine
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Copper	24 hour	please discuss with laboratory
Note: Special container from laboratory before collection.		

Cortisol	24 hour	less than 240 nmol/24hrs
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Creatinine Clearance	up to 1 month	29 - 69 ml/min/1.73m ²
<i>Note : A 24 hour urine sample and coincident 0.5 ml heparin blood sample is required. please indicate patient height and weight</i>	1 - 3 months	31 - 91 ml/min/1.73m ²
	3 - 6 months	44 - 109 ml/min/1.73m ²
	6 - 12 months	51 - 165 ml/min/1.73m ²
	12 - 18 months	65 - 200 ml/min/1.73m ²
	2 - 12 years	90 - 173 ml/min/1.73m ²

This test is NOT the same as eGFR	adult male	90 - 182 ml/min/1.73m ²
	adult female	90 - 155 ml/min/1.73m ²

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Osmolality - usually early morning urine - discuss with lab.

Oxalate - 24 hour	up to 13 years	< 0.35 mmol/24hrs
<i>Note: Special container from laboratory.</i>	adult male	0.19 - 0.48mmol/24hrs
	female	0.27 - 0.52mmol/24hrs

Phosphate Excretion Index contact laboratory

Porphyrins contact laboratory

Protein /creatinine ratio	5 ml urine	< 20 mg/mmol
<i>early am preferred</i>		

Reducing Substances	freshly voided urine	individualised report
within laboratory hours	NB: if specimen can not be sent to lab in core hours, freeze immediately and send frozen	

Faeces

~~Occult Blood~~ ~~dietary restrictions apply~~ **Test no longer available**

Reducing Substances	Specimen must be less than 20 minutes old, or frozen while fresh.
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